

## THE WEATHER AND CIRCULATION OF APRIL 1966

### A Month with Contrasting Temperature Regimes

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#### 1. MEAN CIRCULATION

Significant changes occurred from March to April in the mean circulation and its accompanying weather patterns in the United States. During both months the zonal index was below normal, with the continuing fall in April in accord with normal seasonal changes.

April's mid-tropospheric circulation in the Pacific included a deep Aleutian Low and mid-Pacific trough, and a strong ridge extending from the eastern Gulf of Alaska southward (figs. 1 and 2). Contributing to the strength of the ridge was a deep low-latitude trough near 145° W. By contrast, in March [1] the Aleutian Low was split, with one cell in the Gulf of Alaska and the other near Sakhalin, separated by a strong ridge in the Bering Sea. The 310-ft. height anomaly center with this ridge moved northward in April and was associated with the blocking anticyclone over the East Siberian Sea (fig. 1). This evolution was accompanied by retrogression of the high-latitude portion of the eastern Pacific trough and by deepening with little change in position of the low-latitude portion.

Retrogression also occurred from March to April over North America. The greatest change was observed in the West where the ridge over the Rockies in March moved to a mean position off the Pacific coast in April. Similarly the Low in northwestern Greenland retrograded along with its accompanying trough. Retrogression of the trough in the eastern United States was less pronounced there than at high latitudes, presumably because of the stationary character of the low-latitude eastern Pacific trough. The ridge which developed along the east coast of the United States in April was extremely weak and upper heights were below normal from the Continental Divide to the Atlantic coast. Blocking persisted in eastern Canada in April with little change from its March strength.

The greatest change in circulation was in the Atlantic where 700-mb. heights decreased as much as 840 ft. Accompanying this change was the appearance in April of a deep Low southwest of Iceland. At the same time the westerlies and principal storm track [2] were displaced far to the south of their March positions. Storminess in the Atlantic increased markedly as sea level pressures

decreased to values averaging 14 mb. below normal in the mean Low near 50° N., 28° W.

Zonal flow across Asia in March gave way to an amplified circulation in April. Heights increased over western Russia as a strong ridge developed there. This was partly in response to the circulation upheaval in the Atlantic and to the deeper than normal trough in the Mediterranean. The increase of blocking over the polar regions may also have been a contributing factor. Mean sea level pressures associated with this blocking were as much as 18 mb. above normal north of Novaya Zemlya, the greatest surface pressure anomaly in the Northern Hemisphere in April. Although upper-level heights over eastern Asia decreased little in response to ridging upstream, the flow became much more cyclonic with the principal mean trough over the Sea of Japan. The circulation in April favored the expansion southward of the cool conditions which were observed in central Asia during March.

The principal axis of maximum west wind was near its normal position across the Pacific, western North America, and eastern Asia. Elsewhere over the hemisphere, however, this jet axis was generally displaced south of its normal April position, in association with blocking at high latitudes. Wind speeds in the jet were strongest, with respect to normal, over the eastern Atlantic and central Pacific, and weakest in the eastern Pacific.

#### 2. TEMPERATURE

Unseasonably cool conditions prevailed over much of the Nation in April as temperatures averaged below normal in most areas from the Rocky Mountain States to the east coast (fig. 3). Greatest departures, as much as 4° to 6° F., were observed in the Upper Great Plains. Another region of unusually cool weather was in Virginia and along coastal areas of the Middle Atlantic States where departures were -4° F. Cool conditions were associated with northwesterly flow over western North America (fig. 1) which brought frequent outbreaks of cold Canadian air into the United States. Note also (fig. 2) that the anomalous flow was northerly. It emanated from a source region over western Canada that was much colder than normal. Sea level pressure over North America

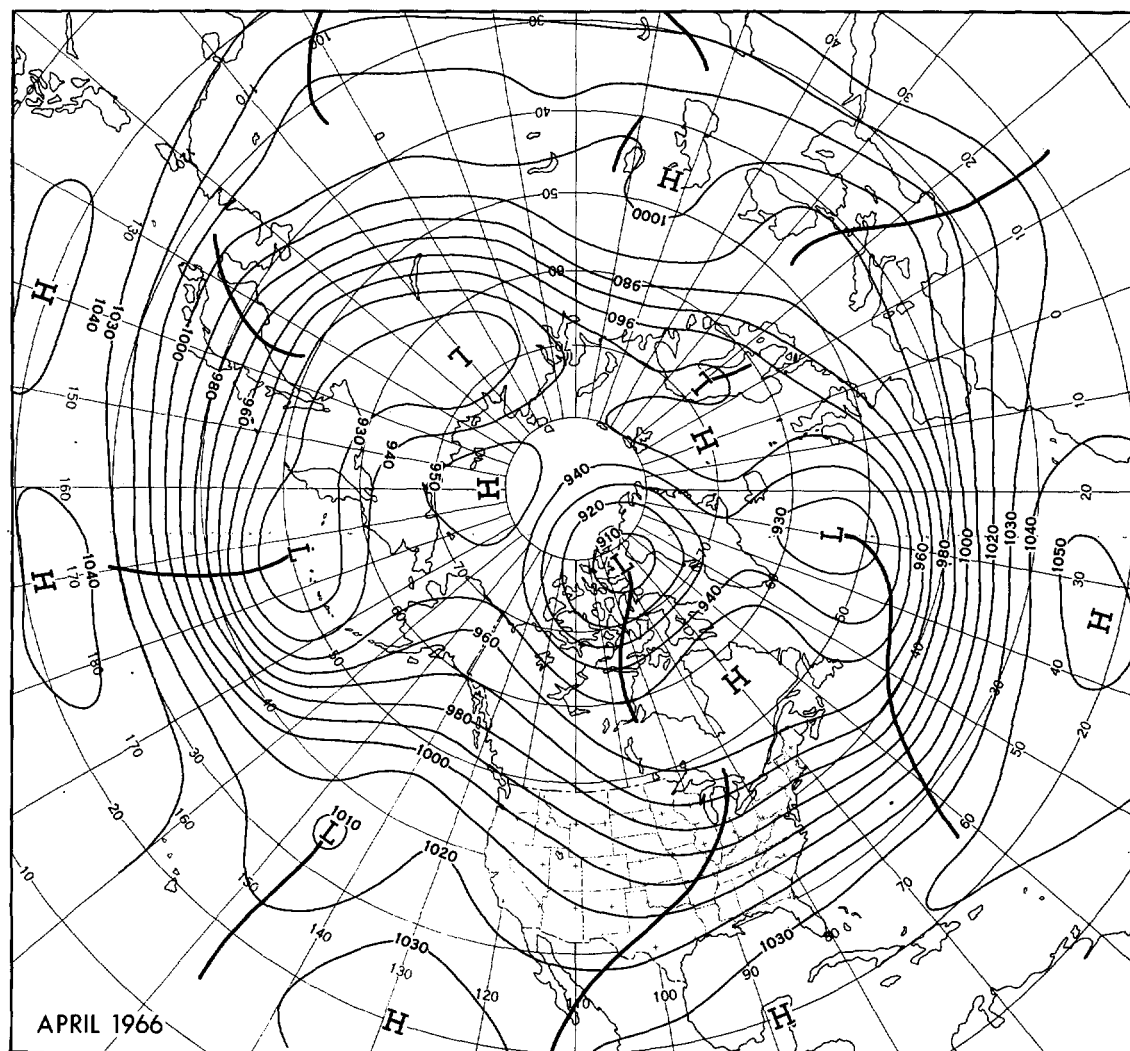


FIGURE 1.—Mean 700-mb. contours (tens of feet) for April 1966. Trough in mid-United States was responsible for cool, wet weather from Southern Plains to Lower Lakes Region.

averaged slightly higher than normal in all areas except the southern United States, thus indicating a general southward drift of polar air masses. The Far West and portions of the Gulf States were warmer than normal. Above normal 700-mb. heights were related to warmth in the West where northeasterly anomalous flow in California brought unusually warm conditions to the interior valleys. This was the warmest April of record (since 1878) at Sacramento, Calif., as temperatures there averaged 6.7° F. above normal.

Coolness in April was in marked contrast with the mild weather in March [1]. In some areas of the Northern and Central Plains temperatures lowered from the much above normal category in March to much below in April. The only important warming which occurred was in California where most stations were warmer by two classes (out of 5\*).

\*The upper and lower octiles, and the middle three quartiles.

### 3. PRECIPITATION

Unusually wet weather prevailed in April in a broad area from the Southern Plains and Lower Mississippi Valley to the Lower Great Lakes (fig. 4.) Rainfall amounts were twice normal in many areas and up to three times normal in parts of northeastern Texas. Recurring heavy rains which accompanied thunderstorms here caused flash flooding, considerable property damage, and some loss of life. Conditions were worst in the Dallas-Fort Worth area. One of the heaviest rainfall totals was at Dallas where 15.40 in. fell, the greatest April rainfall of record. A new April rainfall record was also established at Louisville, Ky. (9.56 in.), while in many other areas near-record amounts were reported. At Charleston, W. Va., where drought has been of increasing concern, this was the first month in which precipitation was above normal since September 1965. Heavy rains in the Central States and South were related to the deep mean trough

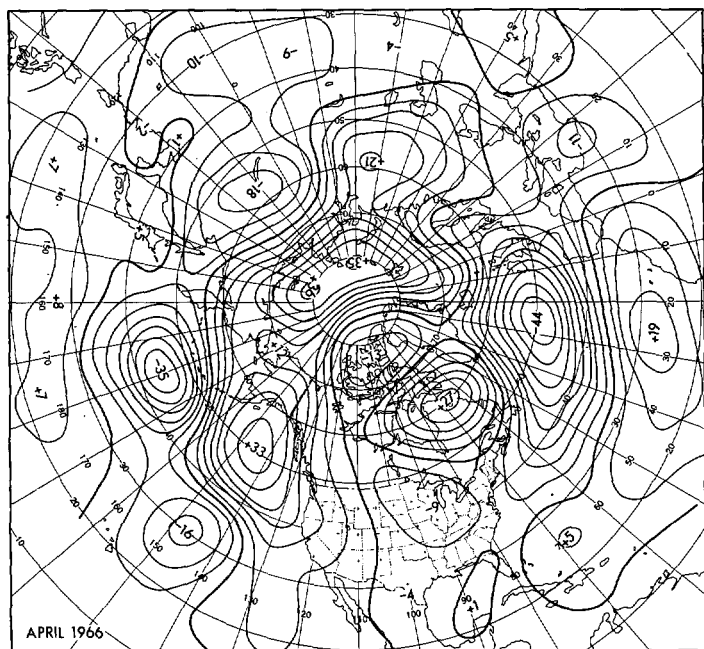


FIGURE 2.—Departure of mean 700-mb. heights from normal (tens of feet) for April 1966. Extensive areas of positive height anomaly at high latitudes reflect blocking and low zonal index over much of the hemisphere.

which extended from the Great Lakes to the Southern Plains.

Another, but much smaller area of above normal precipitation was in the Dakotas. Most of this was associated with two storms moving from the central Rockies, each accompanied by a new outbreak of cold air. Days with snowfall were well above the average in April. At Bismarck, N. Dak., there were 15 such days and at Rapid City, S. Dak., there were 13.

Generally dry conditions prevailed elsewhere over the Nation. Dry weather in the Far West was favored by the strong ridge off the coast and by the prevailing northerly component of anomalous flow (figs. 1, 2). Rainfall of 0.08 in. at Pendleton, Oreg., was the second lowest of April record (since 1890).

The area east of the Appalachians was also dry. Storms from the West weakened considerably as they moved eastward into the area where the upper flow in the mean ridge along the coast was more anticyclonic than usual. Dry conditions returned to New England after three months of near normal precipitation. Blocking over eastern Canada was an important factor in keeping migratory storms south of New England.

There was no improvement in drought conditions over much of the Northeast during April. The exception was in the Potomac Basin region where near to slightly above normal rainfall in April decreased the drought intensity. The following is quoted from the *Weekly Weather and Crop Bulletin* [2] regarding water supplies in the Northeast: "Although recent rainfall in much of the Northeast has

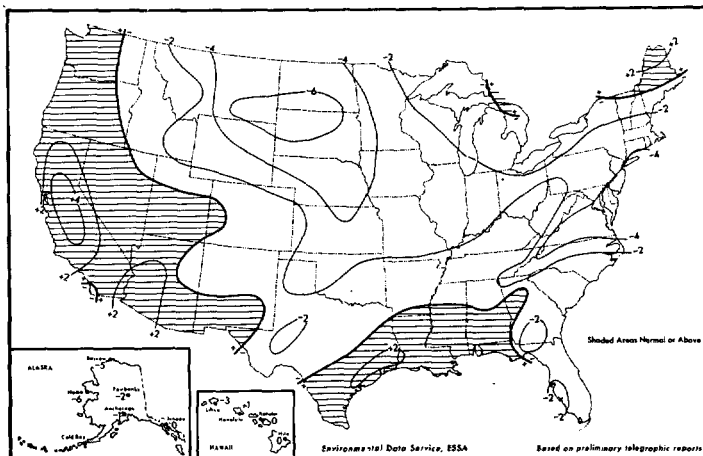


FIGURE 3.—Departure of average surface temperature from normal (°F) for April 1966 (from [3]). Cool weather prevailed over most of the Nation.

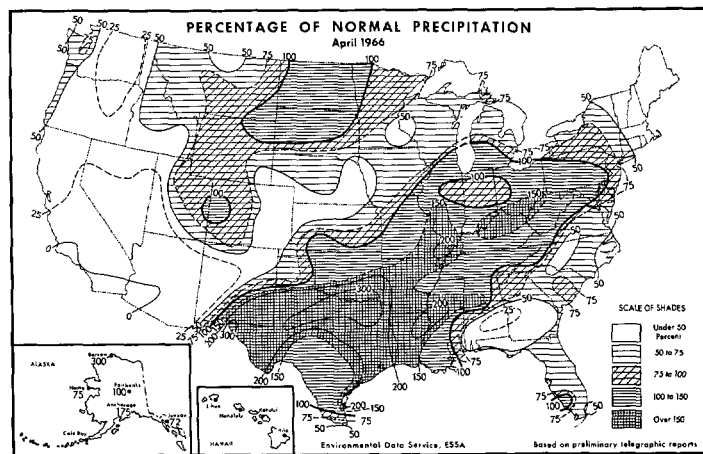


FIGURE 4.—Percentage of normal precipitation for April 1966, (from [3]). Much of the Far West was dry, while Texas and the Lower Mississippi Valley were unusually wet.

been very light, earlier storms and late winter snowfalls have produced a significant improvement in metropolitan water supplies. According to reports by the Delaware River Basin Commission, on May 4 the reservoirs of the New York water supply system were at 79.0% of capacity. Since the storage one year ago was only 54.6% of capacity, this is a gain of more than 50% in 12 months. However, the normal storage value at this time of year is 95.2% of capacity, so there is still a substantial deficiency."

#### 4. HALF-MONTHLY CIRCULATION AND WEATHER PATTERNS

APRIL 1-15, 1966

April's mean circulation over North America featured contrasting flow patterns, each with its differing temper-



the trough over western Canada developed southward as a full-latitude feature. At the same time the Atlantic coast trough was forced eastward and replaced by a strong ridge.

The response of temperature to this circulation reversal was abrupt as an extensive surge of cold Canadian air moved across the West shortly after mid-month, bringing an end to the unseasonable warmth (fig. 6C). Numerous daily minimum temperature records were established from the 18th to 21st in the Northwest and through the Upper Plains. At Casper, Wyo., the temperature fell to  $-4^{\circ}\text{F}$ . on the 19th, a record for any April. Subfreezing temperatures caused considerable damage to fruit crops in eastern Colorado, and also in northern Texas on the 20th. Heavy snowfall accompanied the cold weather in parts of Wyoming and South Dakota on the 18th. Rapid City, S. Dak., received 7 in., while up to 2 ft. fell in the Black Hills. After a brief period of moderation of the cold, a second surge of Canadian air moved into the Northwest on the 26th.

Under the influence of southerly flow and above normal upper heights the East warmed considerably from the early April cold (fig. 6). The greatest warming occurred in the Ohio Valley where temperature anomalies rose  $10^{\circ}$  to  $14^{\circ}\text{F}$ . Below normal temperatures in the Northeast were largely the result of a cold High which moved across Quebec late in the month. Cloudiness, precipitation, and easterly winds from abnormally cold offshore water contributed to the cold. Several cities from Minnesota to northern New England established daily minimum temperature records, while  $23^{\circ}\text{F}$ . at Burlington, Vt., on the 27th was also a record for so late in the season.

Much of April's precipitation in the eastern half of the Nation fell during the last half of the month when the upper flow had a strong southerly anomalous component. Heaviest rains fell in northeastern Texas, where Dallas received 12.4 in. during the last nine days. Much of this was related to several slow moving frontal systems which triggered frequent convective activity. Amounts were much lighter east of the Appalachians beneath the upper ridge.

#### REFERENCES

1. L. P. Stark, "The Weather and Circulation of March 1966—Generally Mild and Dry," *Monthly Weather Review*, vol. 94, No. 6, June 1966, pp. 419–425.
2. Environmental Data Service, ESSA, *Climatological Data, National Summary*, vol. 17, No. 4, Apr. 1966.
3. Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, vol. 53, No. 19, May 9, 1966, p. 8.

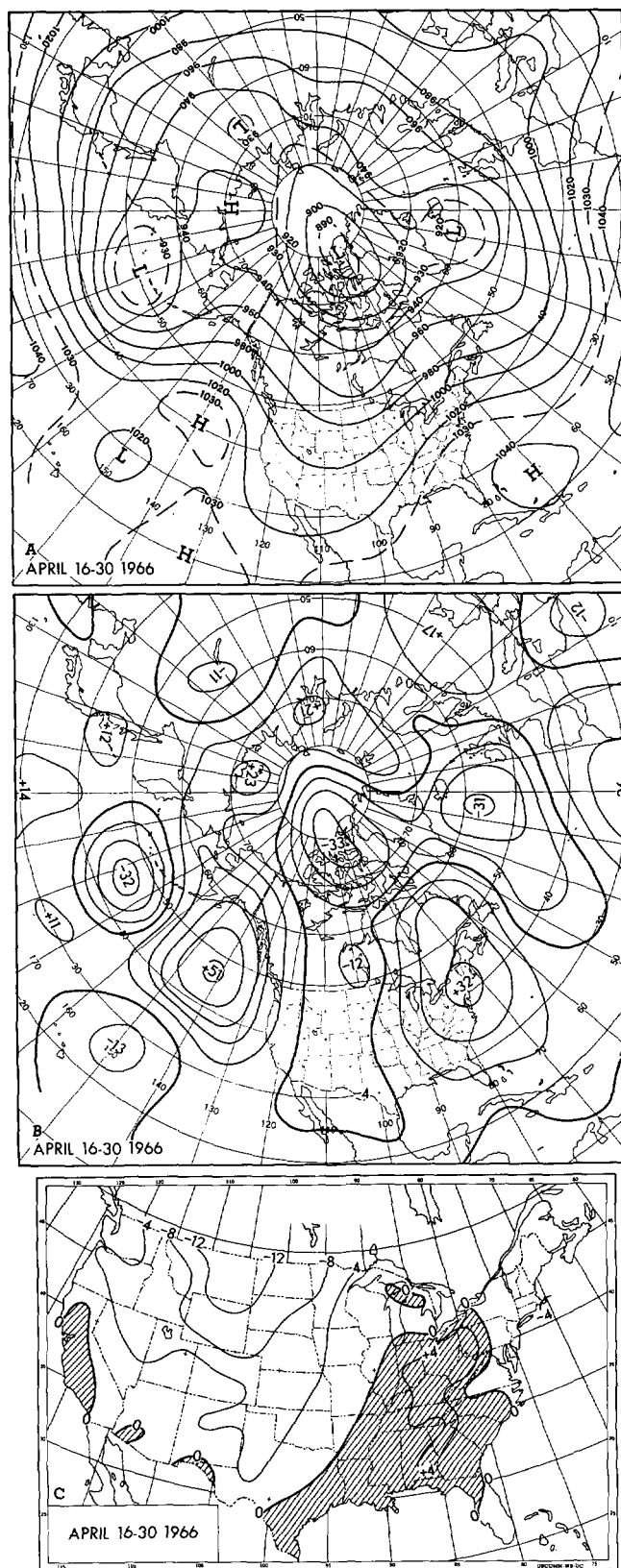


FIGURE 6.—(A) Mean 700-mb. contours, (B) 700-mb. height departure from normal (both in tens of feet), and (C) departure of average surface temperature from normal ( $^{\circ}\text{F}$ .), all for April 16–30, 1966.